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**Chen et al.**

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(54) **TRANSCEIVER LOCKING ASSEMBLY**


(71) Applicant: **INTERNATIONAL BUSINESS MACHINES CORPORATION**, Armonk, NY (US)

(72) Inventors: **Lei Chen**, Shanghai (CN); **Martin Tiernan**, Tucson, AZ (US)

(73) Assignee: **INTERNATIONAL BUSINESS MACHINES CORPORATION**, Armonk, NY (US)



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This patent is subject to a terminal disclaimer.

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(51) **Int. Cl.**
***G06F 21/88*** (2013.01)

(52) **U.S. Cl.**
CPC ..................................... ***G06F 21/88*** (2013.01)

(58) **Field of Classification Search**
CPC ....................................................... G06F 21/88
See application file for complete search history.



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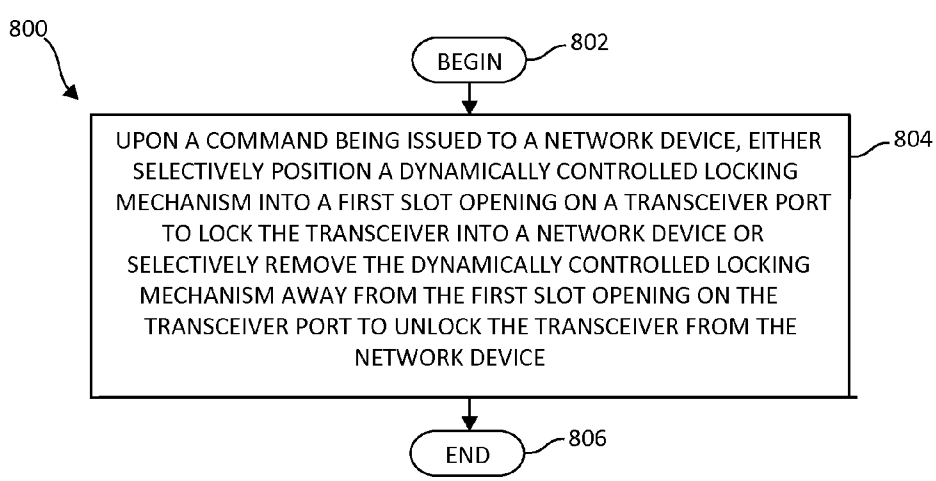
*Primary Examiner* — Chau Le
(74) *Attorney, Agent, or Firm* — Griffiths & Seaton PLLC

(57) **ABSTRACT**


A transceiver locking assembly includes at least one processor device, a network device, in a network environment, in communication with the least one processor device, a transceiver in communication with the network device; a transceiver port, coupled to the network device, defining a first slot opening in at least one of a variety of positions of the transceiver port and configured for selectively receiving the transceiver, and a dynamically controlled locking mechanism coupled to the transceiver port. The dynamically controlled locking mechanism is selectively positioned into the first slot opening to lock the transceiver into the network device or selectively removed away from the first slot opening to unlock the transceiver from the network device.


**9 Claims, 8 Drawing Sheets**



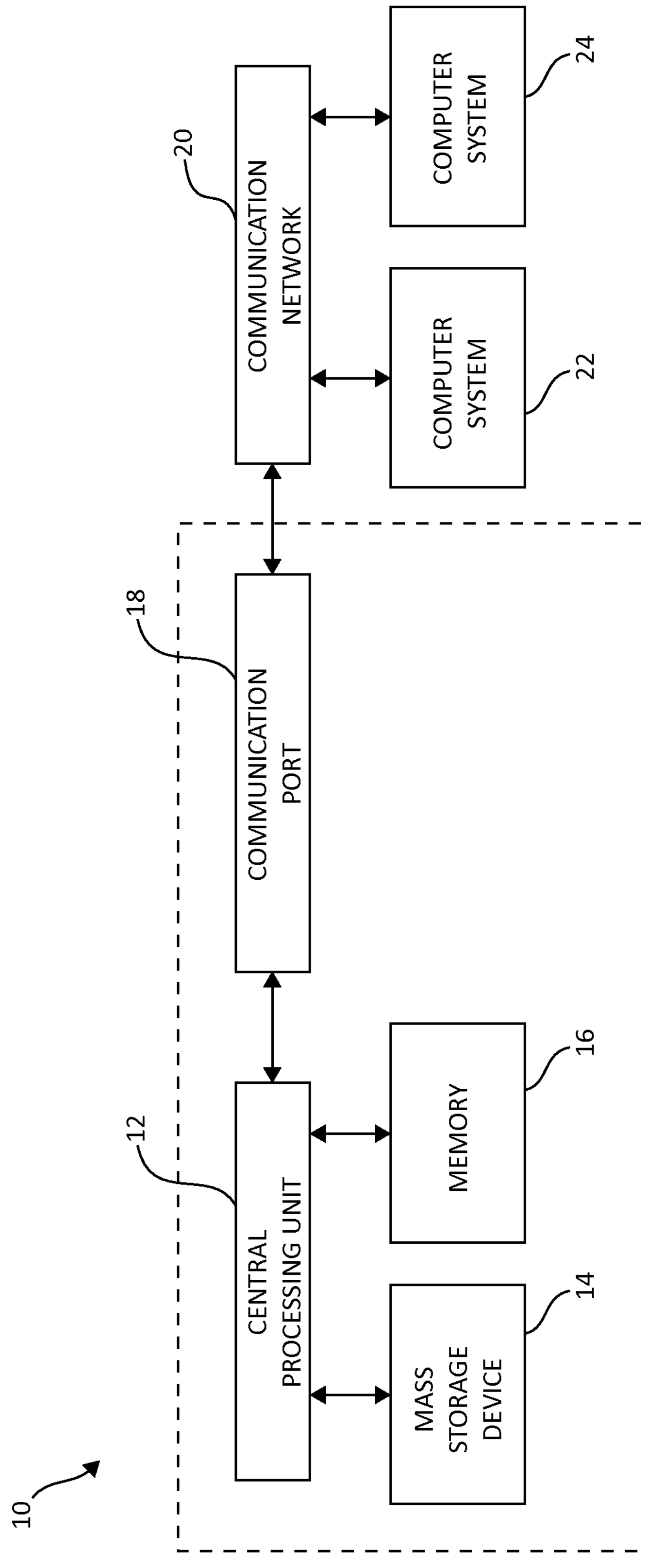

10
12
CENTRAL PROCESSING UNIT
14
MASS STORAGE DEVICE
16
MEMORY
18
COMMUNICATION PORT
20
COMMUNICATION NETWORK
22
COMPUTER SYSTEM
24
COMPUTER SYSTEM

FIG. 1

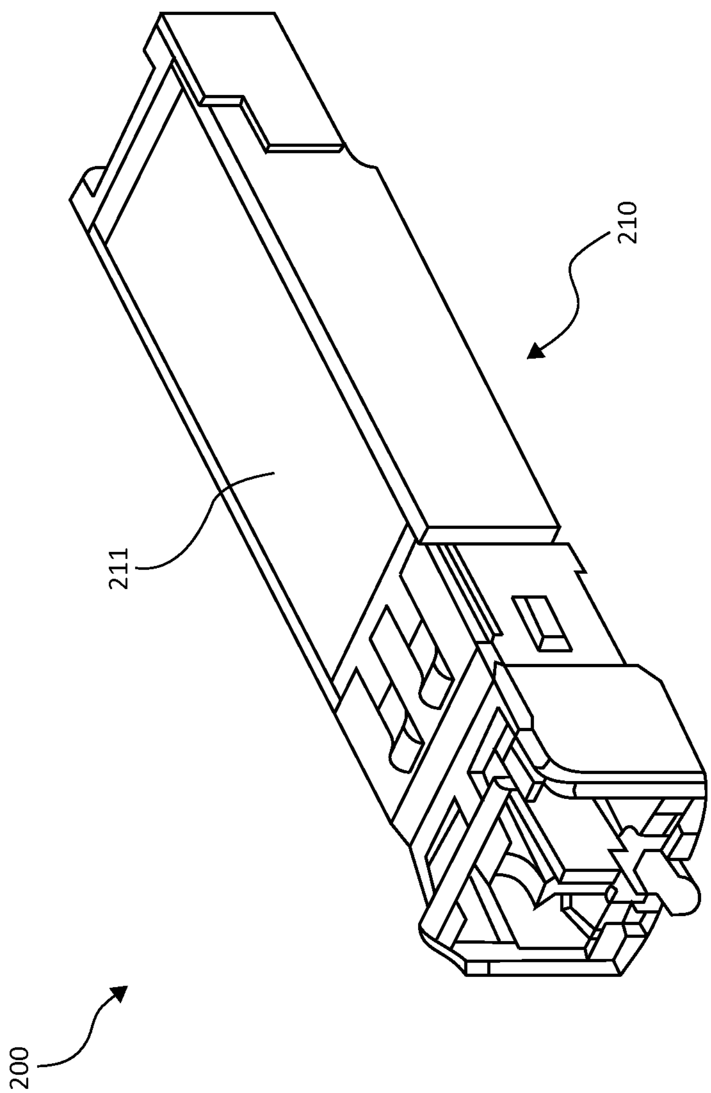



FIG. 2

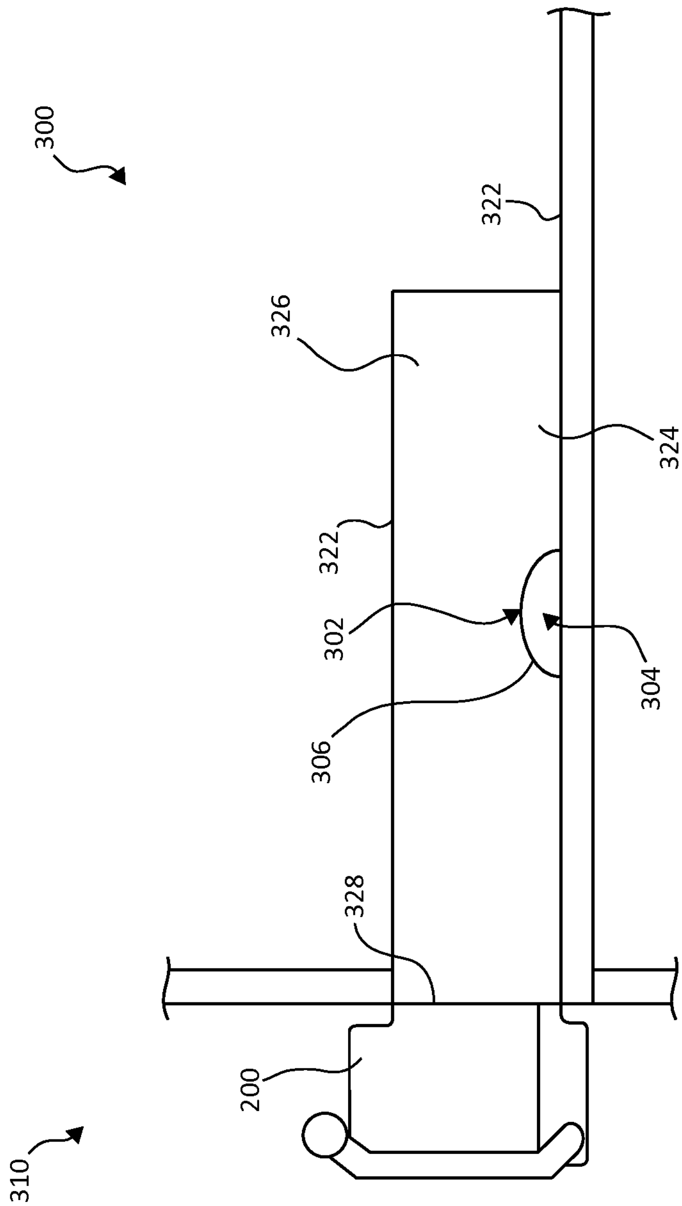



FIG. 3

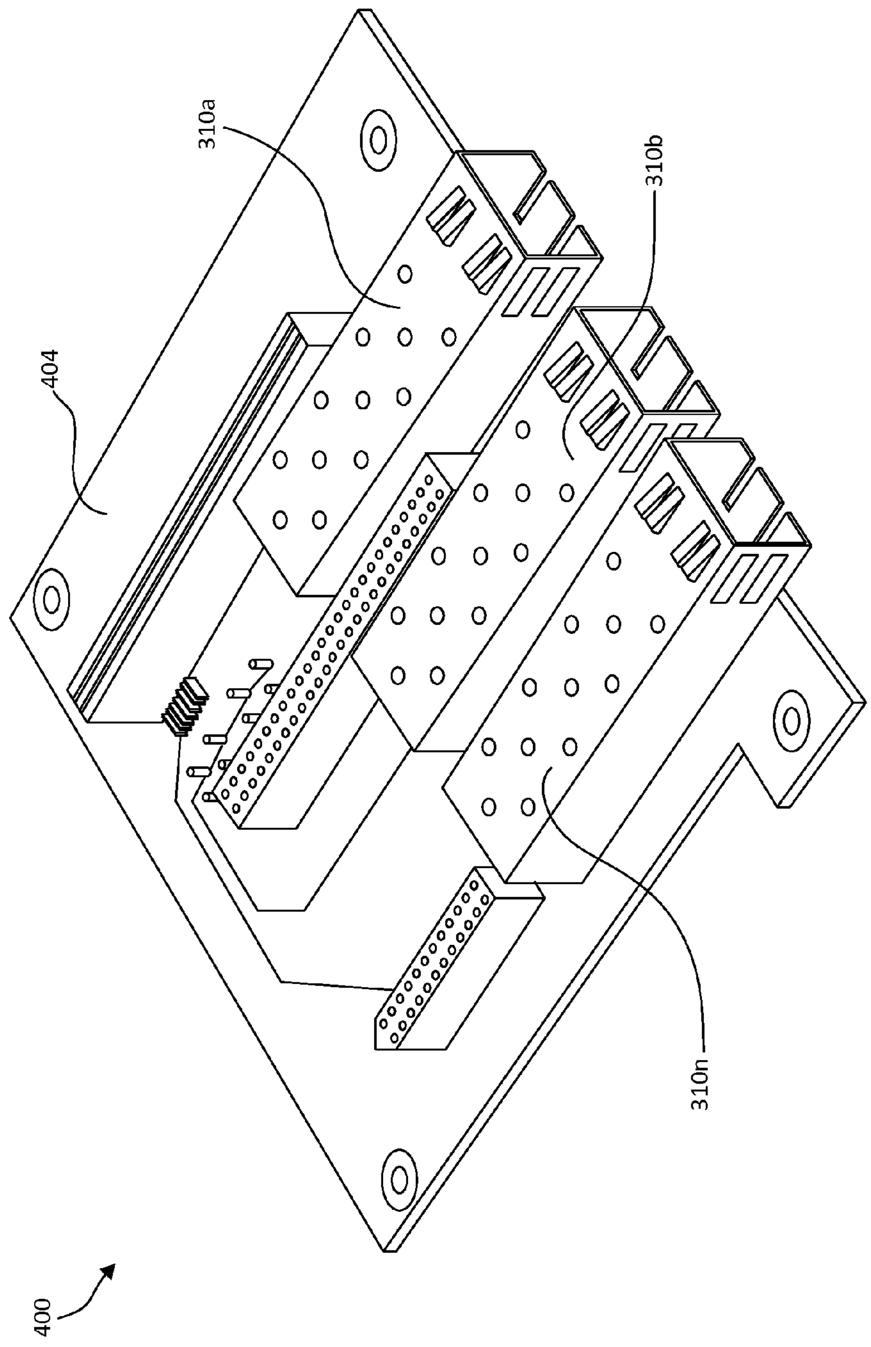



FIG. 4

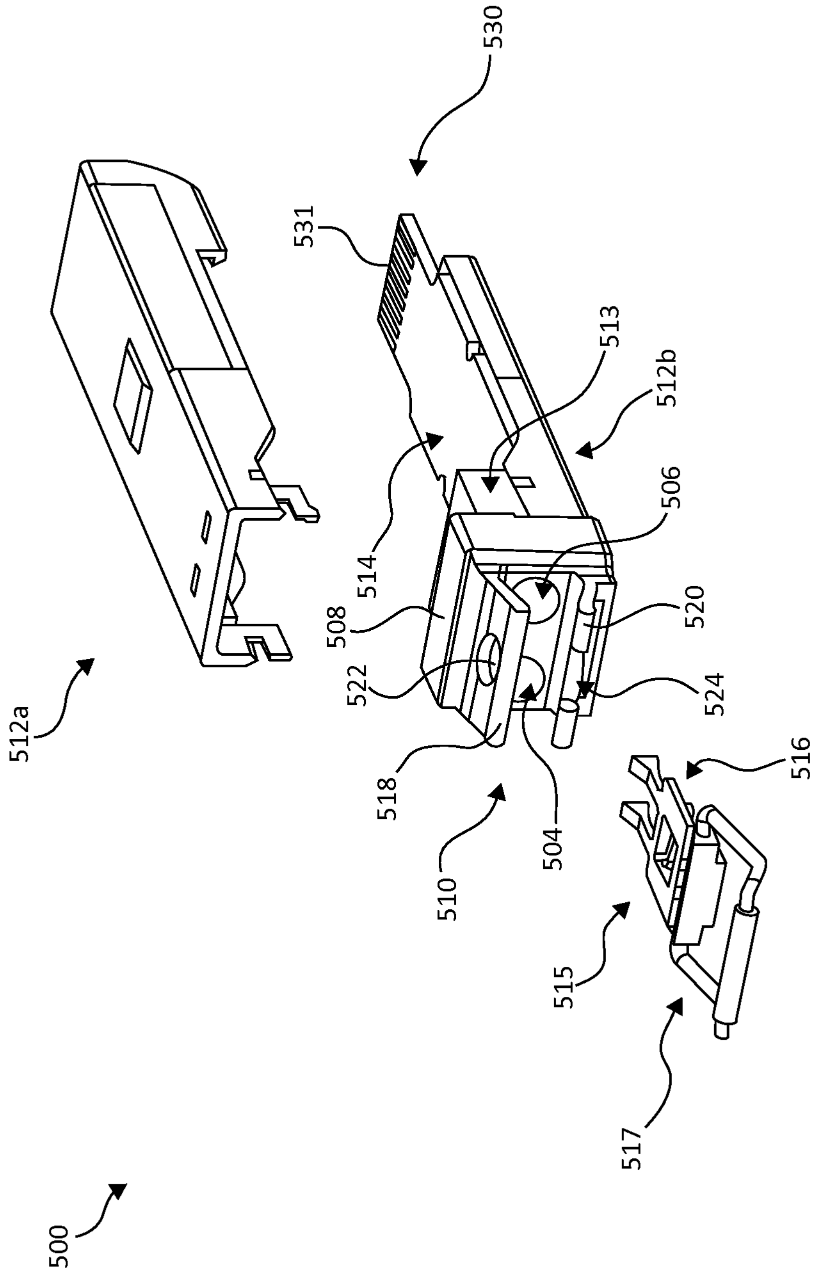

530
531
513
512b
506
514
508
520
522
524
512a
518
516
504
510
515
517
500

FIG. 5

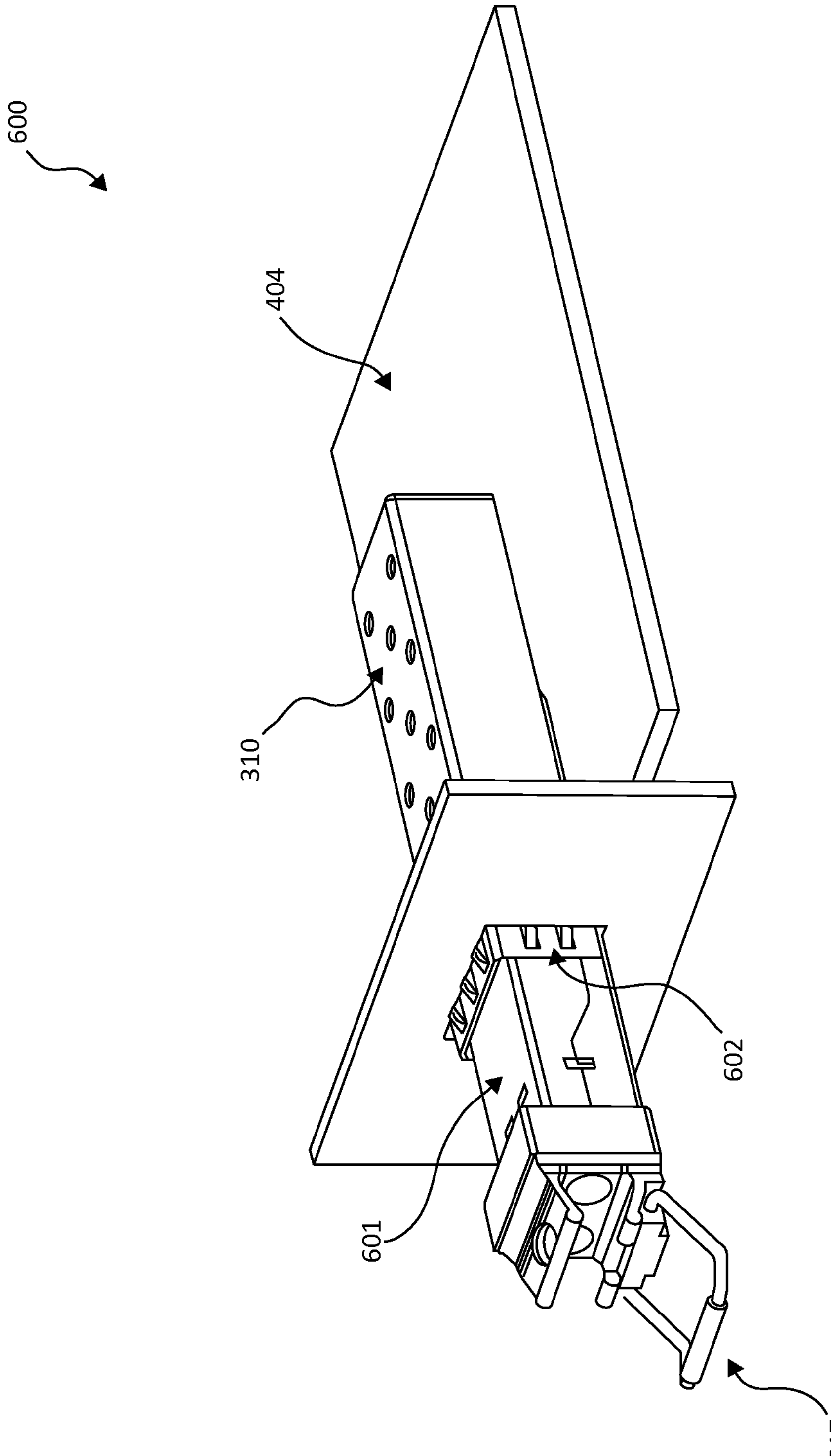



FIG. 6

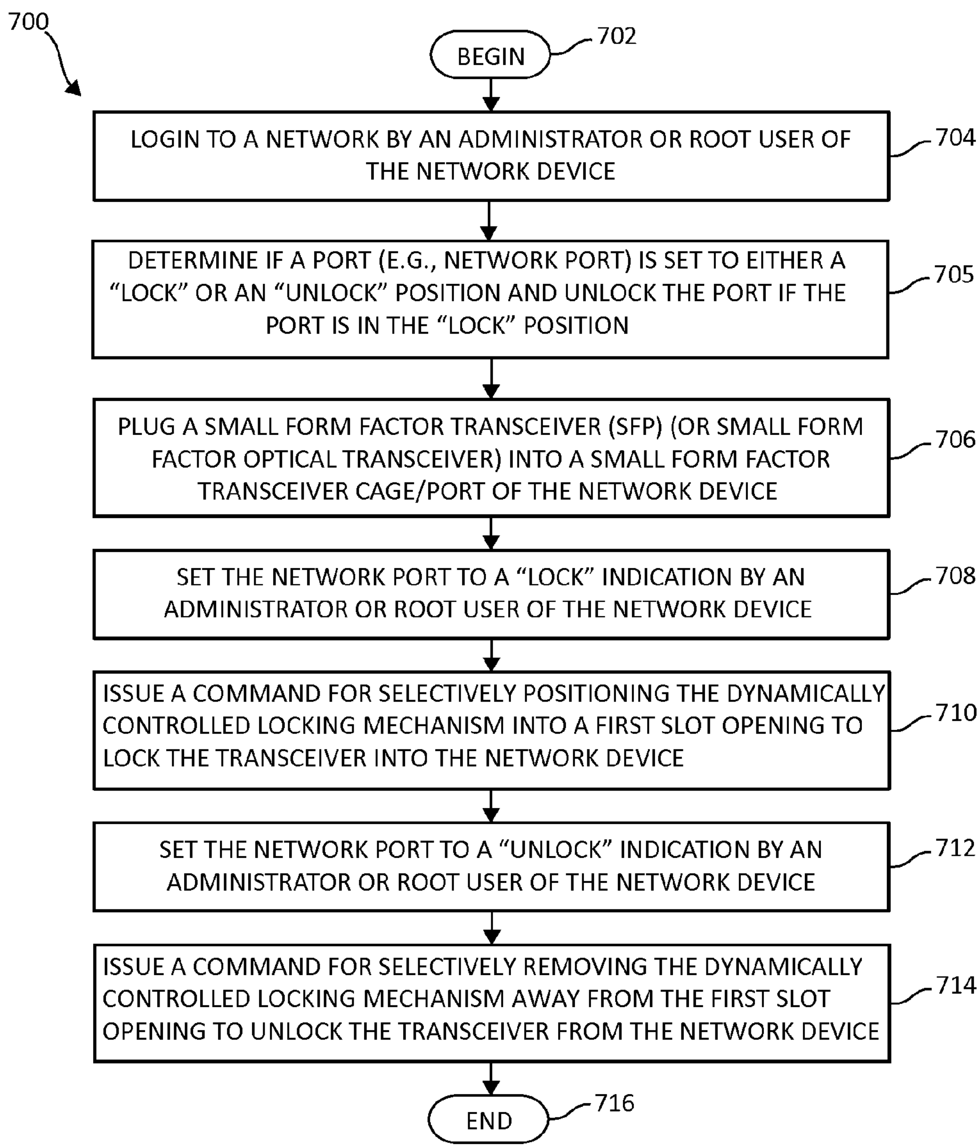

700
BEGIN
702
LOGIN TO A NETWORK BY AN ADMINISTRATOR OR ROOT USER OF THE NETWORK DEVICE
704
DETERMINE IF A PORT (E.G., NETWORK PORT) IS SET TO EITHER A "LOCK" OR AN "UNLOCK" POSITION AND UNLOCK THE PORT IF THE PORT IS IN THE "LOCK" POSITION
705
PLUG A SMALL FORM FACTOR TRANSCEIVER (SFP) (OR SMALL FORM FACTOR OPTICAL TRANSCEIVER) INTO A SMALL FORM FACTOR TRANSCEIVER CAGE/PORT OF THE NETWORK DEVICE
706
SET THE NETWORK PORT TO A "LOCK" INDICATION BY AN ADMINISTRATOR OR ROOT USER OF THE NETWORK DEVICE
708
ISSUE A COMMAND FOR SELECTIVELY POSITIONING THE DYNAMICALLY CONTROLLED LOCKING MECHANISM INTO A FIRST SLOT OPENING TO LOCK THE TRANSCEIVER INTO THE NETWORK DEVICE
710
SET THE NETWORK PORT TO A "UNLOCK" INDICATION BY AN ADMINISTRATOR OR ROOT USER OF THE NETWORK DEVICE
712
ISSUE A COMMAND FOR SELECTIVELY REMOVING THE DYNAMICALLY CONTROLLED LOCKING MECHANISM AWAY FROM THE FIRST SLOT OPENING TO UNLOCK THE TRANSCEIVER FROM THE NETWORK DEVICE
714
END
716

FIG. 7

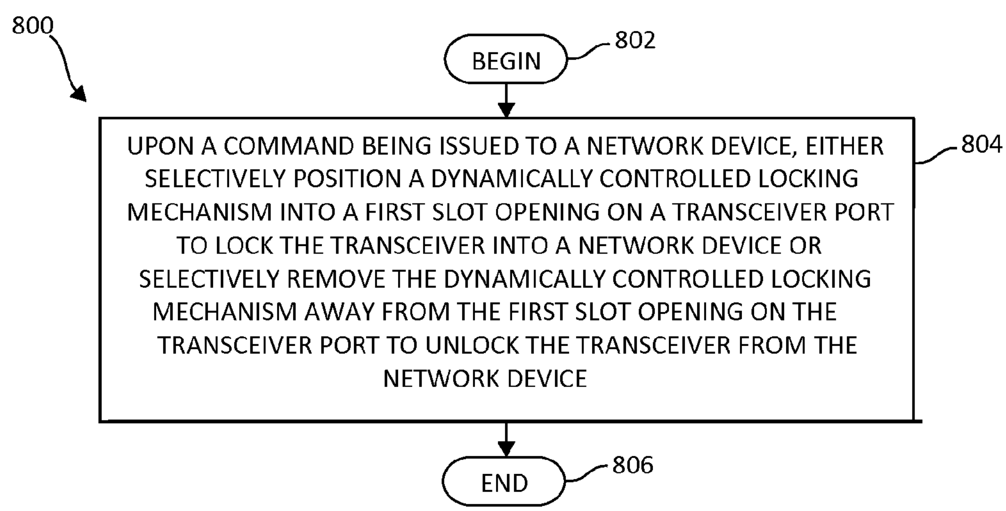

800
BEGIN
802
UPON A COMMAND BEING ISSUED TO A NETWORK DEVICE, EITHER SELECTIVELY POSITION A DYNAMICALLY CONTROLLED LOCKING MECHANISM INTO A FIRST SLOT OPENING ON A TRANSCEIVER PORT TO LOCK THE TRANSCEIVER INTO A NETWORK DEVICE OR SELECTIVELY REMOVE THE DYNAMICALLY CONTROLLED LOCKING MECHANISM AWAY FROM THE FIRST SLOT OPENING ON THE TRANSCEIVER PORT TO UNLOCK THE TRANSCEIVER FROM THE NETWORK DEVICE
804
END
806

FIG. 8

# TRANSCEIVER LOCKING ASSEMBLY

## CROSS REFERENCE TO RELATED APPLICATIONS

This application is a Continuation of U.S. patent application Ser. No. 13/757,186, filed on Feb. 1, 2013.

## FIELD OF THE INVENTION

The present invention relates in general to computers, and more particularly to a transceiver locking assembly in a computing environment.

## DESCRIPTION OF THE RELATED ART

In today's society, computer systems are commonplace. Computer systems may be found in the workplace, at home, or at school. Computer systems may include networking systems, data storage systems, or disk storage systems, to process and store data. Small form-factor pluggable (SFP) transceivers are devices used as an interface between a network device (e.g., switch, router, host adapter) and a fiber optic or copper networking cable. They can be plugged into ports on network devices and easily removed. This makes them subject to removal by mistake or by unauthorized persons, causing disruption to network traffic, data loss and downed links between devices. SFPs are difficult to track, very small and can be easily sold online and by other means. SFPs have become very expensive with some types costing thousands of dollars or more. The temptation for theft as well as the risk to data loss and network outages creates a need for a motorized locking mechanism to lock an SFP into its port, making it impossible to remove without the owner's permission.

## SUMMARY OF THE DESCRIBED EMBODIMENTS

Various device and method embodiments, for a transceiver locking assembly are included. The transceiver locking assembly includes at least one processor device, a network device, in a network environment, in communication with the least one processor device, a transceiver in communication with the network device; a transceiver port, coupled to the network device, defining a first slot opening in at least one of a variety of positions of the transceiver port and configured for selectively receiving the transceiver, and a dynamically controlled locking mechanism coupled to the transceiver port. The dynamically controlled locking mechanism is selectively positioned into the first slot opening to lock the transceiver into the network device or selectively removed away from the first slot opening to unlock the transceiver from the network device.

In addition to the foregoing exemplary embodiment, other exemplary system and computer product embodiments are provided and supply related advantages. The foregoing summary has been provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter. The claimed subject matter is not limited to implementations that solve any or all disadvantages noted in the background.

## BRIEF DESCRIPTION OF THE DRAWINGS

In order that the advantages of the invention will be readily understood, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments that are illustrated in the appended drawings. Understanding that these drawings depict embodiments of the invention and are not therefore to be considered to be limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings, in which:

FIG. **1** is a block diagram illustrating a computing system environment in which aspects of the present invention may be realized;

FIG. **2** is a perspective view illustrating of a small form factor pluggable (SFP) transceiver in which aspects of the present invention may be realized;

FIG. **3** is a block diagram illustrating an dynamically controlled locking mechanism in small form factor transceiver locking assembly in which aspects of the present invention may be realized;

FIG. **4** is a block diagram illustrating an dynamically controlled locking mechanism in small form factor transceiver locking assembly in which aspects of the present invention may be realized;

FIG. **5** is a perspective view of an small form factor optical transceiver shown partially disassembled in which aspects of the present invention may be realized;

FIG. **6** is a perspective view of an small form factor optical transceiver shown assembled in which aspects of the present invention may be realized;

FIG. **7** is a flow chart illustrating an exemplary method for locking and unlocking the small form factor transceiver in which aspects of the present invention may be realized; and

FIG. **8** is a flow chart illustrating an additional exemplary method for locking and unlocking a transceiver in which aspects of the present invention may be realized.

## DETAILED DESCRIPTION OF THE DRAWINGS

As shall be described herein, a transceiver module may be used with communications equipment, and connects to the communications equipment for bi-directional transmission of data between an outside communications interface and the communications equipment. A transceiver module may be an electrical transceiver module used in an electrical-electrical interface, or an optoelectrical transceiver module used in an optic-electrical interface.

In one embodiment, a small form-factor pluggable (SFP) module is inserted into an electrical connector receptacle and connects to a host connector connected to a circuit board. The SFP module typically includes a transceiver for either copper or fiber optic based network systems. Moreover, the small form-factor pluggable (SFP) transceivers may be devices used as the interface between a network device switch, router, host adapter) and a fiber optic or copper networking cable. The SFP transceivers may be plugged into ports on network devices and easily removed. This makes them subject to removal by mistake or by unauthorized persons, causing disruption to network traffic, data loss and downed links between devices. Given the relatively small sizes of the SET transceivers, the SFP transceivers can be easily sold online or by other means, and are difficult to track and monitor. The SFP transceivers have become very expensive. The temptation for theft, as well as the risk to data loss and network outages, builds a compelling case for the ability to lock an SFP into its port, making it impossible to remove without the owner's permission.

Currently, SFP transceivers are inserted into a network device port, and stay in place by a simple friction mechanism, which keeps them inserted so as not to inadvertently be removed during cable removal. They are, however, not permanently locked, but only secured to the network device by using a small lever that releases the friction, making it possible to easily remove. Having the ability to actually lock an SFP transceiver into its port would prevent theft and any other inadvertent or unauthorized removal. Therefore, a need exists for a small form factor transceiver locking assembly to dynamically lock and unlock the SFP transceivers to the network device/port (e.g., switch, router, host adapter), a fiber optic or copper networking cable.

In one embodiment, a transceiver locking assembly is provided. The transceiver locking assembly includes at least one processor at least one processor device, a network device, in a network environment, in communication with the least one processor device, a transceiver (e.g., a small form factor pluggable transceiver) in communication with the network device; a transceiver port, coupled to the network device, defining a first slot opening in at least one of a variety of positions of the transceiver port and configured for selectively receiving the transceiver, and a dynamically controlled locking mechanism coupled to the transceiver port. The dynamically controlled locking mechanism is selectively positioned into the first slot opening for one of locking the transceiver into the network device and selectively positioned from the first slot opening for unlocking the transceiver from the network device upon a command being issued to the network device.

In one embodiment, a transceiver locking assembly is provided. The transceiver locking assembly includes at least one processor at least one processor device, a network device, in a network environment, in communication with the least one processor device, a transceiver (e.g., a small form factor pluggable transceiver) in communication with the network device, a transceiver port, coupled to the network device, defining a first slot opening in at least one of a variety of positions of the transceiver port and configured for selectively receiving the transceiver, and a dynamically controlled locking mechanism coupled to the transceiver port. A second slot opening is defined in at least one of a variety of positions on the transceiver. The dynamically controlled locking mechanism is selectively positioned into the first slot opening and the second slot opening for one of locking the transceiver into the network device and selectively positioned from the first slot opening and the second slot opening for unlocking the transceiver from the network device upon a command being issued to the network device.

In one embodiment the present invention allows a tranceiver to be locked in place (e.g., locked into a tranceiver cage/port) and unlocked using a dynamically controlled locking mechanism by issuing a command from a user interface such as a command line interface (CLI) or graphical user interface (GUI) and the like. In one embodiment, a tranceiver is prevented from being inserted into a tranceiver port/tranceiver cage, which prevents an unauthorized connection from being achieved, making access to data impossible. Issued commands (e.g., a “lock tranceiver” and an “unlock tranceiver” command) for locking and unlocking the dynamically controlled locking mechanism may only be issued after a user has authenticated with required authority to issue the commands. After either the locking and/or unlocking command is successfully issued, a mechanism within the hardware system, e.g., fiber channel switch, ethernet switch, host bus adapter card, network interface card, and the like would may be used engage or disengage the lock. The dynamically controlled locking mechanism may be a small solenoid, motor or other mechanical device that may be electrically/dynamically controlled. In one embodiment, the dynamically controlled locking mechanism includes a small pin, locking device, button, or tab or the like would enter into and/or be released from a hole or recess (e.g., a slot opening) in the tranceiver port/cage and/or transceiver itself, thus creating the lock. The tranceiver may be locked to prevent its removal from anyone without the proper authority. The dynamically controlled locking mechanism, by a remote command and thereby functioning as a remotely controlled switching mechanism, may also be engaged in an unoccupied transceiver port/cage in order to prevent unauthorized insertion of a tranceiver, thus preventing unauthorized access to systems and data. In other words, the dynamically controlled locking mechanism is controlled by a remote command. The dynamically controlled locking mechanism also prevents an insertion of the transceiver into the transceiver port by a remote command. It should be noted that the mechanisms of the present invention does not require or use a manual locking/latching device. In one embodiment, the dynamically controlled locking mechanism may not be accessed manually and may not not be visible when the tranceiver is installed. In one embodiment, a software code/algorithm is used to engage the lock and the software code/algorithm utilizes security features that allow only certain user who have the required authority to be able to lock and unlock the tranceiver. Thus, the software code/algorithm, using the dynamically controlled locking mechanism, prevents unauthorized removal of the tranceiver and may also prevent unauthorized insertion of a tranceiver when the lock_tranceiver command is issued to an unoccupied port/cage (e.g., the locking pin/tab of the dynamically controlled locking mechanism may protrude into the cage (which my have a first slot opening) thus preventing an SFP from being inserted). The dynamically controlled locking mechanism prevents removal and/or even insertion of a tranceiver without the required authority, and the dynamically controlled locking mechanism is operated remotely using software code. In one embodiment, the dynamically controlled locking mechanism applies only to small form factor pluggable (SFP) transceivers and other removable transceivers, except for not small form factor (SFF) transceivers.

In one embodiment, the present invention uses a command line interface (CLI) or graphical user interface (GUI) that requires a user to login with root authority and issue a command to remotely release the tranceiver. In one embodiment, the dynamically controlled locking mechanism utilizes an automated dynamically controlled locking mechanisms (e.g., a solenoid or motor), which would release a pin or tab that inserts into a recess or slot in the tranceiver (the slot opening may be a second slot opening and the port or cage may have the first slot opening) and thus differs from a latching mechanism which temporarily keeps the SFP transceiver in place and/or can be removed by anyone who may manually remove the transceiver, such as using a bail/handle that may be physically grasped and manually pulled to released a transceiver.

Turning now to FIG. **1**, exemplary architecture **10** of a computing system environment, in which aspects of the present invention may be realized, is depicted. The computer system **10** includes central processing unit (CPU) **12**, which is connected to communication port **18** and memory device **16**. The communication port **18** is in communication with a communication network **20**. The communication network **20** and storage network may be configured to be in communication with server (hosts) **24** and storage systems, which may include storage devices **14**. The storage systems may include hard disk drive (HDD) devices, solid-state devices (SSD) etc., which may be configured in a redundant array of independent disks (RAID). The operations as described below may be executed on storage device(s) **14**, located in system **10** or elsewhere and may have multiple memory devices **16** working independently and/or in conjunction with other CPU devices **12**. Memory device **16** may include such memory as electrically erasable programmable read only memory (EEPROM) or a host of related devices. Memory device **16** and storage devices **14** are connected to CPU **12** via a signal-bearing medium. In addition, CPU **12** is connected through communication port **18** to a communication network **20**, having an attached plurality of additional computer host systems **24**. In addition, memory device **16** and the CPU **12** may be embedded and included in each component of the computing system **10**. Each storage system may also include separate and/or distinct memory devices **16** and CPU **12** that work in conjunction or as a separate memory device **16** and/or CPU **12**. It should be noted that the above described computing system is illustrated, by way of example only, as one type of environment the present invention may be used in and also using at least one or more of the central processing units (CPU) **12**.

FIG. **2** is a perspective view illustrating of a small form factor pluggable (SFP) transceiver **200** in which aspects of the present invention may be realized. With reference to FIG. **2**, a small form-factor pluggable (SFP) transceiver module **210** is a compact, SFP transceiver **210** used for both telecommunication and data communications applications. The SFP transceiver module **210** interfaces a network device mother board (see FIG. **4 404**) (e.g., for a switch, router, media converter or similar device) to a fiber optic or copper networking cable. SFP transceiver modules **210** are designed to support SONET, Gigabit Ethernet, Fibre Channel, and other communications standards. The SFP transceiver **210** allows greater port density (e.g., a greater number of transceivers per cm along the edge of a mother board). SFP transceiver modules **210** are available with a variety of different transmitter and receiver types, allowing users to select the appropriate transceiver **210** for each link to provide the optical transmission characteristics required over the available optical fiber type (e.g., multi-mode fiber or single-mode fiber). Optical SFP transceiver modules are available in several different categories. SFP transceivers modules **210** are also available with a copper cable interface, allowing a host device designed primarily for optical fiber communications to also communicate over unshielded twisted pair networking cable. The SFP transceivers modules **210** have capabilities for a variety data rates. A portable SFP transceiver modules **210** can be successively inserted to quickly and easily determine their respective vendors or vendor-specific specifications until the correct vendor's SFP transceiver module or otherwise compatible SFP transceiver module **210** is located (e.g., from among many SFP transceiver modules carried by the user in the field) for use as a replacement. The SFP transceiver module **210** may have one or more slot openings (not shown) defined in one or more positions on the SFP transceiver module **210** for receiving a dynamically controlled locking mechanism. For example, a slot opening may be located on a top, bottom, side, or back location of the SFP transceiver module **210**.

FIG. **3** is a block diagram illustrating a dynamically controlled locking mechanism in small form factor transceiver locking assembly in an SFP transceiver cage **310** in which aspects of the present invention may be realized. It should be noted that the term SFP transceiver cage is used and described herein, but the term network port may also be used and interchanged with the SFP transceiver cage **310**. Thus, for simplicity the term SFP transceiver cage **310** is used but may be interchanged/replaced with a network port for describing the present invention. For example, in one embodiment, the SFP transceiver cage **310** is located inside the network port. The SFP transceiver cage **310** comprises an upper shell **322** and a lower shell **324** that are mated to define a module retention chamber **326**. The module retention chamber **326** is accessible through an open front end **328**. Lower shell **324** includes a locking mechanism **306** located in one of multiple location types, such as on the base portion **332**. A slot opening and/or groove **302** will be made on a SFP transceiver cage/port **310** (e.g., a slot opening may be made on the network port or the SFP transceiver cage and/or on both the network port and the SFP transceiver cage), and a motor driven button, pin, shaft, or other type of locking device **304** will be added on a SFP transceiver slot. As illustrated in FIG. **4**, the SFP transceiver cages/network port **310** (FIG. **3 310** and illustrated in FIG. **4** as **310***a-n* from FIG. **3**) may be coupled to and/or soldered to a circuit board **404** (see FIG. **4 404**) of a networking device (not shown).

In one embodiment, the SFP transceiver (see FIG. **2 200** and/or FIG. **5 500** and herein referenced only for FIG. **2 200** for simplicity) may be dynamically locked into the SFP transceiver cage **310** of the network port in which the SFP transceiver (see FIG. **2 200** and/or FIG. **5 500**) is plugged into, making it impossible for the SFP transceiver (FIG. **2 200**) to be removed until it is unlocked by dynamically releasing the locking mechanism. The SFP transceiver cage **310** of the network device (not shown), which accepts the SFP transceiver (FIG. **2 200**), would have a dynamically controlled mechanism (e.g. a solenoid) **304** that may engage/lock the SFP transceiver (FIG. **2 200**) using the locking mechanism **306**. The small form factor transceiver locking assembly **306** would engage the SFP transceiver (FIG. **2 200**) via a specially designed slot, tab, or other opening or groove **302** thereby making it impossible to remove the SFP transceiver while the SFP transceiver (FIG. **2 200**) is inserted into the port without a root user (or a user having proper authority/credentials) of the network device may issue a command from a command line interface (CLI) or graphical user interface (GUI) which would release the SFP transceiver thereby making it possible to remove it from the network device. Each port on a switch may be marked as locked/unlocked. The status of the switch may set by the switch administrator for indicating whether the SFP transceiver is locked and/or unlocked. After the SFP transceiver (FIG. **2 200**) is plugged into the slot (e.g. the SFP transceiver cage **310** or port), an administrator may change the status on the network port to "locked." At that point, the locking button **304** will be raised up (e.g., raised in a substantially perpendicular manner to the base of the port) up into a slot of the SFP transceiver (FIG. **2 200**) to stop the SFP transceiver (FIG. **2 200**) from being removed. It should also be noted that the locking button **304** may be inserted into the slot opening of the SFP transceiver in one of a variety of manners depending on the location of the slot opening on the SFP transceiver. For example, if the slot opening is located on the rear, back portion of the SFP transceiver, the locking button **304** may be inserted into the slot opening of the SFP transceiver in a substantially horizontal position and/or one of a variety of angled positions (e.g., horizontal to the base of the network port). Alternately, if the port is set to unlocked, the button, pin, and/or shaft of the locking mechanisms **304** may be lowered down, so that SFP transceiver (FIG. **2 200**) may be removed/pulled out freely from the port/cage of the network device. It should also be noted that the locking button **304** may be removed from the slot opening of the SFP transceiver in one of a variety of manners depending on the location of the slot opening on the SFP transceiver. For example, if the slot opening is located on the rear, back portion of the SFP transceiver, the locking button **304** may be removed from the slot opening of the SFP transceiver in a substantially horizontal position and/or one of a variety of angled positions (e.g., horizontal to the base of the network port).

Only an administrator and/or a user with appropriate permissions that have been granted may be able to control the button **304** to release and/or lock the SFP transceiver (FIG. **2** **200**) from the SFP transceiver cage **310** in the network port of the network device (not shown), which accepts the SFP transceiver (FIG. **2** **200**). In one embodiment, to remove the SFP transceivers (FIG. **2** **200**) from the SFP transceiver cage **310** (e.g., an opening of a receptacle of the network device), the locking mechanism **306** must be disengaged by receipt of the command issued by administrator and/or by a user with appropriate permissions granted may be able to control the locking mechanism.

FIG. **5** is a perspective view of a small form factor pluggable (SFP) optical transceiver **500** shown partially disassembled in which aspects of the present invention may be realized. In addition to the SFP transceiver (FIG. **2** **200**), in SFP optical communications systems, an optical fiber cable having a transmit optical fiber and an optical fiber cable having a receive optical fiber are terminated on their ends with a duplex connector that plugs into a duplex receptacle of the SFP housing. The duplex receptacle is secured to the housing of the duplex SFP system. The housing of the duplex SFP system is typically configured to be inserted into a cage. The housing includes an optical system, two active optical elements (i.e., a light source and a light detector), and electrical circuitry. FIG. **5** illustrates a perspective view of the SFP optical transceiver module **500** in its partially disassembled form that may also be locked and unlocked according to the embodiments described herein. In accordance with the embodiment described herein, the SFP optical transceiver module **500** includes a duplex receptacle **508**, an upper housing portion **512**A, a lower housing portion **512**B, an optical assembly **513**, an electrical assembly **514**, and a latching mechanism **515**. The upper and lower housing portions **512**A and **512**B are pressed together to cause locking features on the upper and lower housing portions **512**A and **512**B to interlock. In accordance with this embodiment, the electrical assembly **514** comprises a PCB having a plug end **530** with electrical contacts **531** located thereon. As will be described below with reference to FIG. **6**, when the SFP optical transceiver module **500** is inserted into a cage receptacle/network port, the electrical contacts **531** on the plug end **530** come into contact with electrical connections of a communications management system.

The SFP optical transceiver module **500** includes both transmitter and receiver components to form an optical transceiver module. In accordance with an embodiment, the duplex receptacle **508** of the SFP optical transceiver module **500** has a C-shaped opening **510** formed therein that is defined by upper and lower flexible retaining elements **518** and **520**, respectively, for receiving and retaining the duplex fiberoptic connector within the SFP optical transceiver module **500**. This configuration of the duplex receptacle **508** enables the module **500** to have backwards compatibility with existing Versatile Link (VL) connectors that are commonly used in, for example, industrial fiber optic links. Furthermore, the connector and the SFP optical transceiver **500** support the small form factor transceiver locking assembly (FIG. **3** **306**) as described herein. The duplex receptacle **508** has a slot **522** formed in the upper flexible retaining element **518** and a cut-away **524** formed in the lower flexible retaining element **520**.

The housing **512**A, **512**B of the SFP optical transceiver module **500** houses an optical transmitter and an optical receiver, which are not shown in FIG. **5** for ease of illustration. As is known in the art, the optical transmitter generally comprises components for generating an optical signal (e.g., a light source, such as a light-emitting diode (LED) or laser diode), and one or more optical elements for directing the light into the end of a transmit optical fiber. The optical receiver generally comprises the components for receiving an optical signal (e.g., a photodetector or photosensor, such as a photodiode), and one or more optical elements for directing light output from the end of a receive optical fiber onto the photodetector or photosensor. The optical elements of the transmitter and receiver of the module **500** are part of an optical assembly **513** that couples to the duplex receptacle **508**.

As indicated above, the SFP optical transceiver module **500** has an electrical assembly **514** (e.g., a PCB) that includes a plug end **530** for electrically interfacing the electrical circuitry of the module **500** with electrical circuitry of a communication management system (not shown), such as, for example, a network hub, a router, a switch, or any other data communication device or equipment. Thus, the SFP optical transceiver module **500** is "pluggable". The term "pluggable", as that term is used herein, may include the meaning that the module **500** can be plugged into and unplugged from a mating receptacle (not shown) of a communications management system. The act of plugging the module **500** into the mating receptacle of the communications management system causes the electrical interconnections to be made between electrical circuitry of the module **500** and electrical circuitry of the communications management system. In other words, the electrical connection between the plug end **530** and the electrical contacts (not shown) of the communications management system (not shown) is parallel to the direction of insertion of the module **500** into the communications management system. The act of unplugging the module **500** from the communications management system causes the electrical interconnections between the electrical circuitry of the module **500** and electrical circuitry of the communications management system to be removed. The housing **512**A, **512**B may comprise any suitable material. In one embodiment, the housing **512** may be integrally formed from a plastic or similar material using, for example, injection molding or other manufacturing techniques. In other embodiments, the housing **512** may comprise separate components made of other materials, which are joined together to form the optical transceiver module **500**. The SFP transceiver module **500** may have one or more slot openings (not shown) defined in one or more positions on the SFP transceiver module **500** for receiving a dynamically controlled locking mechanism. For example, a slot opening may be located on a top, bottom, side, or back location of the SFP transceiver module **500**.

The latching mechanism (FIG. **3** **306**), which operates to lock and unlock the optical transceiver module **500** to a SFP transceiver cage and/or a network port (FIG. **3** **310**) and will be described with reference to FIG. **6**. FIG. **6** illustrates a perspective view of the SFP optical transceiver **500** shown in FIG. **5** as the module **500** is being inserted into a housing **602** of a SFP transceiver cage and/or a network port (FIG. **3** **310**) of a communications management system **600**. The SFP transceiver cage (FIG. **3** **310**) may be connected and/or coupled to a printed circuit board (PCB) (FIG. **4** **404**), which is also part of the communications management system **600**. The PCB (FIG. **4** **404**) includes electrical interconnections (not shown) that come into contact with the electrical contacts **531** located on a plug end of the electrical assembly (not shown), which is typically a PCB (FIG. **5** **504**).

In one embodiment, the SFP optical transceiver **500** may be dynamically locked into the SFP transceiver cage (FIG. **3**

310) of the network port in which the SFP optical transceiver 500 is plugged into, making it impossible for the SFP optical transceiver 500 to be removed until it is unlocked by dynamically releasing the locking mechanism. The SFP transceiver cage (FIG. 3 310) of the network device (not shown), which accepts the SFP optical transceiver 500, would have a dynamically controlled mechanism (e.g. a solenoid) (FIG. 3 304) that may engage/lock the SFP from within the locking mechanism 306. The small form factor transceiver locking assembly 306 would engage the SFP optical transceiver 500 via a specially designed slot, tab, and/or other opening or groove 302 thereby making it impossible to remove while inserted into the port. A root user of the network device may issue a command from a command line interface (CLI) or graphical user interface (GUI) which would release the SFP transceiver thereby making it possible to remove it from the network device. Each network port may include a switch that may be marked as locked/unlocked. The setting of the switch may be dynamically controlled using a software algorithm. In one embodiment, the switches are remotely controlled for setting and changing the status of the locking mechanism. In one embodiment, one or more locking mechanisms may be used for locking the SFP transceiver into the network port. In such a case, more than one slot openings may be required for accommodating each of the locking mechanisms. For example, there may be a locking mechanisms located on the top, rear and/or both sides of the network port.

The status of the switch may be set (e.g., dynamically and/or remotely set) by the switch administrator for indicating whether the SFP transceiver is locked and/or unlocked. After the SFP optical transceiver 500 is plugged into slot (e.g. the SFP transceiver cage See FIG. 3 310), an administrator could change the status to "locked," and the lock button (see FIG. 3 304) may be raised up to prevent the SFP optical transceiver 500 from being removed. It should also be noted that the locking button 304 may be inserted into the slot opening of the SFP transceiver 500 in one of a variety of manners depending on the location of the slot opening on the SFP transceiver 500. For example, if the slot opening is located on the rear, back portion of the SFP transceiver 500, the locking button (see FIG. 3 304) may be inserted into the slot opening of the SFP transceiver 500 in a substantially horizontal position and/or one of a variety of angled positions (e.g., horizontal to the base of the network port see FIG. 3 310).

Alternately, in one embodiment, if the network port is set to "unlocked," the button, pin, and/or shaft of the locking mechanism (FIG. 3 304) may be lowered down, so that the SFP optical transceiver 500 can be pulled out freely. It should also be noted that the locking button (see FIG. 3 304) may be removed from the slot opening of the SFP transceiver 500 in one of a variety of manners depending on the location of the slot opening on the SFP transceiver. For example, if the slot opening is located on the rear, back portion of the SFP transceiver 500, the locking button 304 may be removed from the slot opening of the SFP transceiver 500 in a substantially horizontal position and/or one of a variety of angled positions (e.g., horizontal to the base of the network port see FIG. 3 310).

Only an administrator and/or a user with appropriate permissions that have been granted may be able to control the button, pin, and/or shaft of the locking mechanism to release and/or lock the SFP optical transceiver 500 from the SFP transceiver cage (FIG. 3 310) in the network port of the network device (not shown), which accepts the SFP optical transceiver 500. In one embodiment, to remove the SFP optical transceiver 500 from the SFP transceiver cage (FIG. 3 310) (e.g., an opening of a receptacle of the network device), the locking mechanism (FIG. 3 306) must be disengaged by receipt of the command issued by administrator and/or user with appropriate permissions granted may be able to control the locking mechanism.

FIG. 7 is a flow chart illustrating an exemplary method 700 for locking and unlocking the small form factor transceiver in which aspects of the present invention may be realized. The method begins (step 702) by an administrator and/or root user of the network device logging into a network environment (step 704). The method 700 checks whether the port (e.g., network and/or transceiver port) is set to either a "lock" or "unlock" setting, and if it is locked the method 700 will unlock the transceiver port (step 705). A small form factor pluggable transceiver (SFP) (and/or small form factor optical transceiver) is plugged into a small form factor transceiver cage/port of the network device (step 706). The administrator and/or root user of the network device sets (e.g., remotely and/or dynamically) the network port status to a "lock" indication (step 708) and issues a command for a dynamically controlled locking mechanism (e.g., solenoid, button, pin, lock, bar, or other type of device used for locking) to be selectively positioned, for locking the transceiver into a slot opening in the transceiver and locking the SFP transceiver into the network device (e.g. the dynamically controlled locking mechanism raised upward and away from the transceiver cage/port base into a slot opening/groove opening of the small form factor transceiver cage/port for inserting a locking pin device/button into the slot opening and locking in the transceiver) (step 710). The command may be a command line interface (CLI) or a graphical user interface (GUI). In this "locked" state, the dynamically controlled locking mechanism prevents removal of the small form factor transceiver by remaining in a locked position until receipt of a release/unlock command. The administrator and/or a root user of the network device sets (e.g., dynamically and/or remotely) the network port status to a "unlock" indication (step 712) and issues a command for the dynamically controlled locking mechanism to be selectively positioned for unlocking the locking mechanism from the transceiver (e.g. lowers a locking bin/button device downward and away from the slot opening/groove opening of the SFP transceiver cage/port and/or the SFP transceiver device towards the small form factor transceiver cage base/circuit board) (step 714). In other words, if the network port is set (e.g., dynamically and/or remotely) by the administrator and/or the root user of the network device to indicate the small form factor transceiver is either locked or unlocked, the method 700 may either selectively position the dynamically controlled locking mechanism into an unlocked position in the small form factor transceiver, and/or selectively positioning the dynamically controlled locking mechanism into a locked position in the small form factor transceiver if the network device is set to indicate the small form factor transceiver is locked. The command to unlock the locking mechanisms may include removing (e.g., lowering and/or reversing) the dynamically controlled locking mechanism from a slot opening on the small form factor transceiver and/or the small form factor transceiver cage/port towards the network port (e.g., towards the bottom, sides, and/or top of the network port depending on the location of the slot opening on the transceiver and/or the network port). The command to lock the locking mechanisms may include selectively positioning the dynamically controlled locking mechanism to a locked position in the small form factor transceiver by raising the dynamically controlled locking mechanism from the bottom of the network port into a slot opening on the small form factor transceiver and/or the small form factor transceiver cage/port. The command may be a command line interface (CLI) or a graphical user interface (GUI). The method **700** ends (step **716**).

FIG. **8** is a flow chart illustrating an additional exemplary method **800** for locking and/or unlocking a transceiver in which aspects of the present invention may be realized. The method **800** begins (step **802**). Upon a command being issued to a network device, the dynamically controlled locking mechanism is either selectively positioned into a first slot opening to lock the transceiver into the network device or selectively removed away from the first slot opening to unlock the transceiver from the network device (step **804**). The method **800** ends (step **806**).

As will be appreciated by one skilled in the art, aspects of the present invention may be embodied as a system, method or computer program product. Accordingly, aspects of the present invention may take the form of an entirely hardware embodiment, an entirely software embodiment (including firmware, resident software, micro-code, etc.) or an embodiment combining software and hardware aspects that may all generally be referred to herein as a "circuit," "module" or "system." Furthermore, aspects of the present invention may take the form of a computer program product embodied in one or more computer readable medium(s) having computer readable program code embodied thereon.

Any combination of one or more computer readable medium(s) may be utilized. The computer readable medium may be a computer readable signal medium or a computer readable storage medium. A computer readable storage medium may be, for example, but not limited to, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, or device, or any suitable combination of the foregoing. More specific examples (a non-exhaustive list) of the computer readable storage medium would include the following: an electrical connection having one or more wires, a portable computer diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), an optical fiber, a portable compact disc read-only memory (CD-ROM), an optical storage device, a magnetic storage device, or any suitable combination of the foregoing. In the context of this document, a computer readable storage medium may be any tangible medium that may contain, or store a program for use by or in connection with an instruction execution system, apparatus, or device.

Program code embodied on a computer readable medium may be transmitted using any appropriate medium, including but not limited to wireless, wired, optical fiber cable, RF, etc., or any suitable combination of the foregoing. Computer program code for carrying out operations for aspects of the present invention may be written in any combination of one or more programming languages, including an object oriented programming language such as Java, Smalltalk, C++ or the like and conventional procedural programming languages, such as the "C" programming language or similar programming languages. The program code may execute entirely on the user's computer, partly on the user's computer, as a standalone software package, partly on the user's computer and partly on a remote computer or entirely on the remote computer or server. In the latter scenario, the remote computer may be connected to the user's computer through any type of network, including a local area network (LAN) or a wide area network (WAN), or the connection may be made to an external computer (for example, through the Internet using an Internet Service Provider).

Aspects of the present invention have been described above with reference to flowchart illustrations and/or block diagrams of methods, apparatus (systems) and computer program products according to embodiments of the invention. It will be understood that each block of the flowchart illustrations and/or block diagrams, and combinations of blocks in the flowchart illustrations and/or block diagrams, may be implemented by computer program instructions. These computer program instructions may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other programmable data processing apparatus, create means for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks.

These computer program instructions may also be stored in a computer readable medium that may direct a computer, other programmable data processing apparatus, or other devices to function in a particular manner, such that the instructions stored in the computer readable medium produce an article of manufacture including instructions which implement the function/act specified in the flowchart and/or block diagram block or blocks. The computer program instructions may also be loaded onto a computer, other programmable data processing apparatus, or other devices to cause a series of operational steps to be performed on the computer, other programmable apparatus or other devices to produce a computer implemented process such that the instructions which execute on the computer or other programmable apparatus provide processes for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks.

The flowchart and block diagrams in the above figures illustrate the architecture, functionality, and operation of possible implementations of systems, methods and computer program products according to various embodiments of the present invention. In this regard, each block in the flowchart or block diagrams may represent a module, segment, or portion of code, which comprises one or more executable instructions for implementing the specified logical function(s). It should also be noted that, in some alternative implementations, the functions noted in the block may occur out of the order noted in the figures. For example, two blocks shown in succession may, in fact, be executed substantially concurrently, or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved. It will also be noted that each block of the block diagrams and/or flowchart illustration, and combinations of blocks in the block diagrams and/or flowchart illustration, may be implemented by special purpose hardware-based systems that perform the specified functions or acts, or combinations of special purpose hardware and computer instructions.

What is claimed is:

**1**. A method for locking a transceiver by a processor device comprising:

upon a command being issued to a network device, the network device physically performing one of:

selectively positioning a dynamically controlled locking mechanism into a first slot opening on a transceiver port to lock the transceiver into the network device; and

selectively removing a dynamically controlled locking mechanism away from the first slot opening on the transceiver port to unlock the transceiver from the network device.

**2**. The method of claim **1**, further including performing one of:

preventing removal of the transceiver until receipt of the command, and preventing an insertion of the transceiver into the transceiver port by a remote command.

3. The method of claim 1, wherein the dynamically controlled locking mechanism is a solenoid.

4. The method of claim 1, further including issuing the command to the network device from one of a command line interface (CLI) and a graphical user interface (GUI).

5. The method of claim 1, wherein a second slot opening on the transceiver is defined, and further including:

upon the command being issued to the network device:

selectively positioning the dynamically controlled locking mechanism into the first slot opening on the transceiver port and the second slot opening on the transceiver to lock the transceiver into the network device, and

selectively removing the dynamically controlled locking mechanism away from the first slot opening on the transceiver port and the second slot opening on the transceiver to unlock the transceiver from the network device.

6. The method of claim 5, further including issuing the command from one of an administrator and a root user of the network device upon logging into the network environment.

7. The method of claim 6, further including setting the transceiver port to indicate the transceiver is one of locked and unlocked by one of the administrator and the root user of the network device.

8. The method of claim 7, further including, if the one of the administrator and the root user of the network device sets the transceiver port to indicate the transceiver is unlocked, selectively removing the dynamically controlled locking mechanism away from the first slot opening on the transceiver port and the second slot opening on the transceiver and setting the dynamically controlled locking mechanism in an unlocked position.

9. The method of claim 6, further including, if the one of the administrator and the root user of the network device sets the network port to indicate the transceiver is locked:

inserting the dynamically controlled locking mechanism into the first slot opening on the transceiver port and the second slot opening on the transceiver to lock the transceiver into a network device and setting the dynamically controlled locking mechanism in a locked position.

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